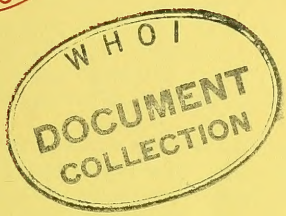
U.S. Army Coastal Engineering Research Center



INTERAGENCY CONFERENCE ON CONTINENTAL SHELF RESEARCH

MISCELLANEOUS PAPER NO. 1-66
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DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS

FOREWORD

A widespread interest in the morphology and sediments of the Continental Shelf has been evidenced by many governmental agencies. Because of this interest, a meeting was sponsored by the Coastal Engineering Research Center, and representatives of the interested Federal agencies were invited to participate.

The purpose of the meeting was to provide a forum at which the various agencies could describe their programs and learn about the programs of other agencies. Thus, key personnel of the agencies would become knowledgeable of the entire Federal research effort on the Continental Shelf. In instances involving similar research objectives or collection efforts, it might be possible for several agencies to initiate cooperative programs. The presentations were to emphasize the magnitude and direction of the research programs rather than specific results of any given project.

This pamphlet contains the proceedings of the Interagency Conference on Continental Shelf Research which was held at the Coastal Engineering Research Center on 13 May 1965.

This publication was compiled by Norman E. Taney, Chief, Geology Branch, and edited by Richard H. Allen, Chief, Publications Branch, Engineering Development Division, Coastal Engineering Research Center.

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WELCOME

Colonel F. O. Diercks, Director, Coastal Engineering Research Center, welcomed the group to the meeting and to the Center. He pointed out that CERC and its staff were the same group that had been known, until the fall of 1963, as the Beach Erosion Board, and that the Center is responsible for the research aspects of beach erosion control, one of the civil works functions of the Army Chief of Engineers. He also noted that the Board still exists with essentially the same membership but is now known as the Coastal Engineering Research Board. After making announcements concerning administrative details and the exhibits, Colonel Diercks introduced Major General Graham, the Director of Civil Works, Corps of Engineers, U. S. Army.

OPENING REMARKS

by

Major General Jackson Graham
President, Coastal Engineering Research Board

Let me add my welcome to the welcome which Colonel Diercks has given you. Our meeting today is one more event which shows the increasing interest our Nation has in the oceans which border our shores. This particular meeting centers on the information that has been gathered - or is planned to be gathered - on the structure of the Continental Shelf areas bordering the U.S.A. and on the materials which compose the bottom.

We need to add to our understanding of the physical structure of the bottom in order to improve our military defenses and in order to indicate the possibility of certain types of mining or construction activities on or beneath the bottom. We need to know the composition of the bottom in order to assess the existence, quantity, and quality of minerals and other substances of economic usefulness to our Nation. This feature has become of increasing interest as our potential for recovery of these bottom materials and our need for them has increased.

The Federal agencies represented here today are the ones having direct responsibilities for studying the structure and composition of the shelf, for informing our people of their findings, and to a degree, of recognizing the potential usefulness of these findings to our defense and to our economy. This agency, the Coastal Engineering Research Center, or CERC, as it is commonly referred to, and the Coastal Engineering Research Board, or CERB, which has an overview responsibility toward CERC, have

jointly recognized that the agencies present are engaged in diverse bottom sampling, bottom coring, and bottom structure studies of the shelf. It was also recognized that it would be of considerable value if all the agencies were informed of the studies and sampling activities of the other agencies, including a knowledge of the types of analyses being made on the bottom samples and cores and the storage plan for the bottom samples and cores.

Our meeting today is, then, in the nature of an information interchange on the Continental Shelf studies and sampling activities of the agencies, including their contractors. We are not so much interested today in the conclusions from the studies, but rather in the scope and contents of the field studies, includimg sampling, and the disposition of the field data and the samples.

I will not be able to stay for all of the meeting due to other commitments, but those in the Corps who are most concerned with these matters will be here. I trust you will all find it to be an informative and pleasant meeting - as I believe you will.

Thank you.

INTRODUCTION TO THE CONFERENCE

by

Joseph M. Caldwell
Chief Technical Advisor, CERC

I have been asked to act as Chairman of the meeting, and so my remarks will be in that capacity. All of you have copies of the agenda, and can see that we have promise of an interesting day. I know certain of you have statements or remarks to make but you do not appear by name on the agenda. Please excuse these omissions but your intentions became known to us after we had prepared the agenda, and we have provided time at the end of the meeting this afternoon for all who have additional remarks to make. We have a rather full agenda, as you can see, and I would ask all speakers to help us by keeping to the time as set on the schedule. We hope that each speaker will reserve some time at the end of his talk for questions and discussion.

We will assemble and distribute the proceedings of this conference in a somewhat abbreviated form; the distribution will extend to a number of persons and agencies which are not present. Before publication, the proceedings, as prepared, will be submitted for approval to the individuals who are giving papers.

Our first speaker this morning is Mr. F. J. Barry, The Solicitor of the Department of The Interior.

LEGAL ASPECTS OF THE OWNERSHIP OF CONTINENTAL SHELF RESOURCES

by

Frank J. Barry
Solicitor, Department of The Interior

I am most happy today to have the opportunity and the responsibility of addressing the conference on the legal aspects of ownership of the natural resources on the Continental Shelf. These resources are broadly varied and vitally important to the future development of this country. The location and identification of Continental Shelf resources and the scientific development of techniques for their recovery and utilization is the primary concern of scientists and engineers, both in and out of Government. If the Nation is to realize the potential of this great store of natural resources, it must be through the combined efforts of all Governmental agencies, working in cooperation with the coastal States, private industry and, in appropriate cases, with foreign nations. Such efforts must take place within the context of effective laws and regulations if we are to formulate a policy for the wise conservation and prudent management of these resources.

As an attorney I am concerned with the formulation of effective laws and regulations to permit proper development of Outer Continental Shelf resources, and at the same time, to prevent waste and needless exploitation. The people of this country have paid many times over for the hasty and all-too-often improper exploitation of the natural resources on the public lands of the United States.

Even at present, the system of laws under which such resources are administered is sorely in need of revision and updating - it is, to be sure, a confusing patchwork of laws, regulations, executive orders, judicial pronouncements and ineffective stop-gap measures. Operating under these laws is difficult at best. Yet the Secretary of The Interior is charged with, and must meet, the responsibility to assure that the nonrenewable resources of this country are developed and used wisely and that renewable resources make their full contribution to the progress, prosperity and security of the United States - now and in the future.

The development of a comprehensive and workable set of laws for the administration of natural resources on the Continental Shelf is not an easy task. It is complicated in no small measure by the peculiar nature and location of these resources and by the complex network of Federal, State and international interests therein.

The early exploration, development and exploitation of the Continental Shelf resources preceded adequate legislation and regulations. The need for a major policy statement by the United States and for laws to effectuate such policy was finally manifest when, on September 28, 1945, President Harry S. Truman proclaimed that:

the Government of the United States regards the natural resources of the subsoil and seabed of the continental shelf beneath the high seas but contiguous to the coasts of the United States as appertaining to the United States, subject to its jurisdiction and control. 1/

On the same date, President Truman issued a related Executive Order (No. 9633) reserving, setting aside and placing the natural resources of the Continental Shelf under the control and jurisdiction of the Secretary of the Interior, ". . . for administrative purposes, pending the enactment of legislation in regard thereto."

Legislation was finally enacted in 1953. On May 22, 1953, the Submerged Lands Act (67 Stat. 29, 43 U.S.C., sec. 1301 et seq.) was enacted following the submerged lands decisions (United States v. California, 332 U.S. 19 (1947), United States v. Louisiana, 339 U.S. 669 (1950), and United States v. Texas, 339 U.S. 707 (1950)), in which the Supreme Court rejected the States' claims to the submerged lands of the territorial seas and recognized the paramount rights of the United States thereto. Briefly, the effect of the Submerged Lands Act was to change the law established in the submerged lands cases with respect to the submerged lands adjacent to the coast and seaward of the inland waters of the coastal States. The Act granted or confirmed title to a portion of these lands to the States. The lands granted were those beneath the marginal sea for a distance of three miles seaward of the coastline. The grant extended to three leagues on the Gulf of Mexico for Texas and Louisiana.

The authority of the United States to claim jurisdiction beyond the Submerged Lands Act grant was established by the enactment of the Outer Continental Shelf Lands Act of August 7, 1953. 2/ The provisions of this Act are of primary interest to the Interagency Committee on Oceanography Research.

The principal purpose of this legislation was to provide statutory authority for opening the vast oil and gas resources of the Outer Continental Shelf to exploration and development. Other resources were recognized and, in some cases, were specifically referred to by provisions in the Act. Clearly, however, the full need for scientific research and economic development of the Shelf was not recognized and treated in the Act. It is becoming increasingly apparent that adequate regulation and control of newly discovered resources and uses of the Outer Continental Shelf lands will require further legislation.

Section 4 extends the Constitution and laws and civil and political jurisdiction of the United States to the Outer Continental Shelf lands. The civil and criminal law of adjacent States is adopted as Federal law insofar

1/ Proclamation No. 2667, 59 Stat. 884.
2/ 67 Stat. 462 (1953) 43 U.S.C., sec. 1331 et seq.

as consistent with other Federal law and not inconsistent with "regulations of the Secretary (of the Interior) now or hereafter adopted."

Section 5 of the Outer Continental Shelf Lands Act authorizes the Secretary of the Interior to administer leasing of Outer Continental Shelf lands. It also authorizes the Secretary to ". . . prescribe and amend such rules and regulations as he determines to be necessary and proper in order to provide for the prevention of waste and conservation of the natural resources of the Outer Continental Shelf, and the protection of correlative rights therein . . ."

It is not clear that the Secretary may regulate the activities of other Federal agencies on the Outer Continental Shelf. While the language of Section 5 broadly authorizes the Secretary to promulgate regulations "to provide for the prevention of waste and conservation of natural resources", the context of the Act does not make it certain that such regulations could be used to regulate the activities of other Federal agencies. Section 11 authorizes "any Agency of the United States" to conduct geological and geophysical explorations on the Outer Continental Shelf and also grants such authority to any person "authorized by the Secretary." Apparently, other Federal agencies do not require the Secretary's permission.

Whether the regulation of Federal oceanographic research ought to be centralized in a single Department head or in the Secretary of the Interior seems to me to be a proper matter of concern to the Interagency Committee. The existence of this Committee and the holding of this conference is proof of a widespread recognition of the need for coordination. On the other hand it may well be that Federal activities have not become sufficiently intensive to justify a decision on the final institutional forms our efforts will take.

Some 23 separate agencies in the Federal Government will be involved in some type of research or development program in the oceans on or beyond the Continental Shelf. These agencies spent a total of $123.1 million in Fiscal Year 1964 efforts conducted under the national oceanographic program. The estimates for FY 1966 exceed $140 million. Each participating agency has its separate statutory responsibility, either expressed or implied, for scientific research, geographical exploration or ocean development in the interest of national defense, resource development and conservation, maritime regulation and safety, or public health.

It would serve no useful purpose here to outline or summarize the statutory authority for each such Federal program. Suffice it to say that the number and scope of these programs will inevitably increase rapidly in the future. In addition, important programs may be conducted by private industry. We should remain alert to the increasing needs for effective coordination and regulation of all efforts, governmental and nongovernmental, and we must be prepared at the appropriate time to make our recommendations.

We might inquire at this point as to what programs or types of programs presently fall within the purview of the administrative machinery established

in the Outer Continental Shelf Lands Act. If compared with the broad scope of current Governmental programs, the scope of the Act is very limited, for only those activities which fall generally in the category of "geological and geophysical explorations" are covered by the Act. Section 11 of the Act provides as follows:

> Any agency of the United States and any person (including a natural person, an association, a State, a political subdivision of a State, or a private, public or municipal corporation) authorized by the Secretary (of the Interior) may conduct geological and geophysical explorations in the Outer Continental Shelf, which do not interfere with or endanger actual operations under any lease maintained or granted pursuant to this Act, and which are not unduly harmful to aquatic life in such area.

For your purposes - two points should be clarified here: 1) the scope of Federal activities authorized by this section, and 2) the manner in which Federal agencies may exercise the authority so granted.

First, it is clear from the legislative history of the Act, that the principal purpose of this section was to permit geophysical explorations and to encourage the location of deposits of mineral resources, utilizing seismic and other methods of exploration. The broader aspects of oceanography, hydrographic surveying, and other activities conducted for purposes other than the location of mineral deposits, are not covered by the Act. We must conclude, therefore, that the Outer Continental Shelf Lands Act does not grant blanket authority to the agencies of the United States not otherwise authorized by law to conduct such activities on the Shelf.

It is also clear from the Act that private parties, including the States and political subdivisions thereof, must obtain authorization in the form of a permit from the Secretary of the Interior to conduct geological and geophysical explorations on the Outer Continental Shelf. The provision requiring prior authorization by the Secretary for geological and geophysical explorations was not incorporated in the original version of the Act, but was included at the suggestion of the Department of Justice. In making the suggestion, it is clear that the Department of Justice intended that such requirement be imposed only on private persons and not upon the various agencies of the United States. To date, we have had no serious conflict between Governmental programs and operations conducted under Federal mineral leases on the Continental Shelf. Explorations have apparently been carefully performed without harmful effects on aquatic life in the area.

It is the responsibility of the Secretary of the Interior to prevent interference with or danger to actual operations under Federal mineral leases granted pursuant to the Act and to require that explorations be not unduly harmful to aquatic life in the area. This responsibility, together

with the rule-making and regulatory authority granted to the Secretary under Section 5 for purposes of conservation and the prevention of waste, may provide the statutory authority for regulation which may impinge on activities conducted by other Federal agencies. Thus far, the Secretary has not found it necessary to exercise any significant measure of regulation or control. And perhaps this will never become necessary if, through coordination of Federal programs and care in planning and operation, we can avoid conflicts with leasing programs and danger to aquatic life and prevent waste of natural resources through effective conservation practices.

Lease operations conducted under the Act will not seriously inhibit research and development programs even when large portions of the Continental Shelf are subject to mineral lease. All such leases are issued subject to rights-of-way for pipelines and for other purposes to assure that leasing activities do not unnecessarily interfere with the reasonable and necessary uses of the seabed and subsoil of the Continental Shelf. As a matter of fact, the current regulations permit the issuance of leases for different minerals on the same land area where the simultaneous operation of such leases is feasible and desirable.

I have mentioned previously that the development of a comprehensive and workable set of laws for the administration and development of the natural resources of the Continental Shelf is complicated by the fact that recognition must be given to the impact of international law on all activities conducted on the Outer Continental Shelf. In this regard, the United States has signed and ratified the rules of international law prepared by the International Law Commission and adopted at the 1958 Geneva Conference. The Conference provides the international legal definition of the Continental Shelf and establishes the rights of coastal nations to explore and develop the natural resources therein.

The definition of natural resources as finally adopted in the Convention is very broad and includes minerals and other nonliving resources of the seabed and subsoil and the "living organisms belonging to sedentary species, which, at the harvestable stage, either are immobile on or under the seabed or are unable to move except in constant physical contact with the seabed or the subsoil." Since no precise definition of the term "natural resources" is set out in the Outer Continental Shelf Lands Act, we can assume that term is at least as broad as the definition set out in the Convention. It is important to note that the Convention does have a significant impact upon oceanographic and other scientific research on the Outer Continental Shelf. Article 5 of the Convention provides that the exploitation of natural resources of the Shelf must not "result in any interference with fundamental oceanographic or other scientific research carried out with the intention of open publication." Article 5 also imposes the following conditions upon those desiring to conduct such research:

1) Consent of the coastal nation must first be obtained;

2) Such research must be purely scientific research into the physical or biological characteristics of the Continental Shelf;

3) Results of such research must be published.

Consequently, research previously conducted as a matter of right by this or any nation outside the territorial sea of another nation but on that portion of the Continental Shelf over which such nation has jurisdiction, is seriously curtailed. We must obtain the consent of such nations and comply with the other requirements imposed by the Convention. Those oceanographic research provisions of the Convention have had and will continue to have an important impact upon the "ocean-wide, ocean-deep" efforts included in our national oceanographic program. We must now conceive the means to implement these programs through cooperative agreements with other nations. It is entirely possible, if not probable, that the implementation of such agreements will require further legislation inasmuch as the provisions of the Outer Continental Shelf Lands Act are not well adapted to this purpose.

With regard to cooperative efforts between nations in development and research efforts on the Outer Continental Shelf, I might mention that President Johnson has, by Presidential proclamation, declared this to be International Cooperation Year. Hopefully many of the problems we presently encounter in developing these resources under the Convention may be worked out through study and cooperative efforts during the International Cooperation Year.

SEDIMENTOLOGY PROGRAM AT THE MUSEUM OF NATURAL HISTORY, THE SMITHSONIAN INSTITUTION

by

J. W. Pierce

This is my first official function as an employee of the Museum of Natural History even though I do not assume full-time duties until June 27, 1965.

The Smithsonian Institution was founded for the increase and diffusion of knowledge among men. It first became involved in research in 1846 and now has research facilities in many phases of the sciences.

Unique among governmental activities, the Smithsonian Institution is a private organization that operates on both public and private funds. The first appropriation of Federal funds for operation of the Smithsonian was made in 1877.

The U. S. National Museum, of which the Museum of Natural History is a part, is the official repository of natural history materials for the government of the United States. Contained in the Rules and Regulations of the United States Geological Survey is the following section: "All collections of rocks, minerals, soils, fossils, and objects of natural history, archeology, and ethnology, made by the Coast and Geodetic Survey, the Geological Survey, or by any parties for the Government of the United States, when no longer needed for investigations in progress, shall be deposited in the National Museum." This includes collections made by individuals employed by these agencies. The law, as passed for the Geological Survey, also included other governmental agencies.

The Museum of Natural History has been rather passive with respect to claiming title to collections. The material was accepted if offered for keeping. It appears to be the duty of the agencies involved to deposit the collections in the Museum, not for the Museum to demand the collections. The present operational procedure probably will be maintained.

Two sections of the Smithsonian will be involved in the handling of collections of samples from the ocean floor and the marginal environments. The Smithsonian Oceanographic Sorting Center has a program to assemble samples from the marine environment to be loaned to interested and competent investigators for further study. This is, in essence, a "library" of marine sediment samples. The intent of this program is to assemble from different sources, a large and representative collection of marine sediment samples that will allow lines of investigation to be pursued without the expense and time involved in a collecting expedition. No one is presently filling this role.

Samples will be received from various Federal agencies and from the private oceanographic institutions. In time, there will be a large,

worldwide collection of samples. As the collection grows, some discretion will have to be exercised with regard to accepting and storing samples. Some that are offered may have small value because of past handling practices; others would be cheaper to replace than to pay storage costs.

The Smithsonian Oceanographic Sorting Center is primarily a service organization set up to assist in oceanographic research, both at the oceanographic institutions and at universities, including those not now involved in marine research. Two lines of research are compatible with this service concept:

1) Carefully controlled investigation of the changes that occur in cores and grab samples with respect to method of storage and length of storage time under present storage methods; and

2) Development of new storage methods not presently in use.

The second section of the Smithsonian that will be involved in work with marine sediment samples is the Division of Sedimentology of the Museum of Natural History. This division is charged with the permanent storage of those samples that have immense value, because of information they contain, or because of high replacement costs. Examples of this type of sample would be those from the Mohole and certain deep-ocean samples. The Division would take title and permanently store parts of these samples.

Along with the above responsibility, the Division of Sedimentology will have an active program of research on sediments and sedimentary processes. The program of research is not yet fully defined and will depend a great deal on the wishes of the scientists involved. We do not intend to encroach upon areas that are assigned to other agencies or that are being adequately investigated by other scientists. We welcome cooperative projects with other governmental agencies or with oceanographic institutes.

Concentrated ecologic studies and the sediment influence on plant and animal communities would be an interesting field of research for the Division of Sedimentology. This could be developed in conjunction with the biologists and paleobiologists already established in the Museum. Another field, which does not appear to be overly crowded, is that dealing with diagenetic changes. This does not mean that we would be limited to these areas and, probably, we will not be so limited.

In conclusion, neither of the two programs of the Museum of Natural History will be operative until July 1, 1965. We have high hopes that both programs will contribute to the field of sedimentology.

I will attempt to answer any questions concerning the role of the Smithsonian in the field of sedimentology.

DISCUSSION

Question:

Does the Smithsonian sample "library" expect that all samples will be returned in the condition received?

Answer:

No. Most analyses conducted on sediments are destructive. Some samples would eventually be used up and could not be returned.

Question:

Is the Oceanographic Sorting Center interested in assembling a file of bottom profiles or bottom photographs?

Answer:

No.

Question:

Have any oil companies or private engineering and research firms been contacted to donate samples to the library or is there any intent to do so?

Answer:

Oil companies have not been contacted to date. We hope to do so but have no idea as to the reception that we will receive. Formally, no contact has been made with private engineering and research firms. Some informal discussion has taken place about the availability of the samples for study by private firms or individuals employed by these firms. As set up, the sample "library" is for furtherance of knowledge. It is doubtful if the samples could be loaned out if the information gained is to be kept secret. If the intent is to publish the results, then there would be nothing against these companies using the samples. We intend to set up an Advisory Committee to formulate guidelines and the decision in such cases would be up to this committee.

Question:

How many samples does the Sorting Center have at the present?

Answer:

A very limited number. In fact, a suite of beach samples from Florida and a few manganese nodules from the Indian Ocean. The position for a person to head the geology section is not available until July 1, 1965, and the program will not start operating until then.

SAND INVENTORY PROGRAM

by

Norman E. Taney
Coastal Engineering Research Center

A number of requests over the past five years has caused the U. S. Army Coastal Engineering Research Center (CERC) to initiate its Sand Inventory Program. One such request originated from the District Engineer, U. S. Army Engineer District, Jacksonville, Florida in 1960, who sought information on sources of sand for beach nourishment or beach reconstruction. In another area, New Jersey, the same problem had arisen and was brought into dramatic focus by the great March storm of 1962. In both instances noted and others, it became apparent that in many places conventional sources of sand were becoming or already had been exhausted and that new economical sources of material for beach reconstruction and/or maintenance were necessary. It was logical to look to the nearshore bottom and subbottom for new sources.

In 1961 a literature survey revealed that very little information existed concerning the nearshore bottom and subbottom. Historic U.S.C.& G.S. coast charts were available which, upon comparison, revealed areas of accumulation and erosion. With knowledge of the shore processes functioning for a given reach of shore, it became possible to predict where probable areas of accumulation would be found. On this basis studies were made along the Atlantic coast of the United States. Then, for a variety of reasons, field exploration was begun at four selected areas off the Atlantic coast of New Jersey in June 1964.

The landward and seaward limits of field exploration were approximately 15 and 100 feet below mean low water, respectively. The seaward limit was controlled by the fact that present hopper dredge depth capacity is about 60 feet below water surface; however, with minor modification a depth of 75 feet could be achieved. The additional 25 feet of depth were planned for a new generation of hopper dredges which might be developed as needs became more critical.

Methods of exploration and positioning were considered early in 1962. Means of positioning were available in which the familiar principle of triangulation is utilized. Two slave radar-transponder beacons are placed on shore in known positions and the distance between them is determined very accurately. The master unit on the survey vessel queries each of the slaves (in turn) and the time of response may be reduced to the distance the master is from each slave. Two electro-mechanical arms then plot the position of the vessel on a mylar base map.

The first exploration tool is a geophysical instrument called a "Sparker." Its name is derived from the fact that the energy source looks

like an automobile spark plug. The energy is created as an electrical spark which sends sonic waves through the water to the bottom and subbottom. These waves are refracted and reflected, and return to the surface where detection is accomplished by a string of hydrophones. In this manner a vertical profile of the water column, the surface of the shelf, and stratification beneath the bottom is derived. Originally a single low-powered energy source was used and the record extended from water surface to a depth of about 350 feet. At present two energy sources (one low and one medium) are used and recorded on the same paper. The low-energy portion of the record extends from water surface to a depth of about 150 feet; resolution is about two feet. The medium-energy portion extends from the surface to a depth of about 450 feet; resolution is much less than that from the low-energy signal. This, however, does permit investigation of the deeper stratification and this makes the entire program more attractive scientifically.

The second exploration tool is known as the "Vibracorer." It is a self-supporting, compressed-air-powered coring tool. While the initial penetration capacity was 12 feet, the present capacity is 16 feet. The core is contained in a transparent plastic tube which is approximately three inches in inside diameter. Inasmuch as the tool is free-standing, it is unnecessary to hold the survey boat with more than a single anchor and thus the time required to obtain a core is drastically reduced. The entire operation has never taken more than 15 minutes, after arrival at the core site. Usually the core is sampled at one-foot intervals except when obvious stratification exists. Size distribution analysis of each sample is necessary to determine the suitability of the sediment for beach purposes and to identify those strata which have been detected by the geophysics.

Upon combining the geophysics and data from the cores, it is possible to map areas of suitable sand deposits in three dimensions. With these maps it is possible to derive quantitative data on the volume of material available.

It was mentioned earlier that the work started in June 1964 at four selected areas off New Jersey. The areas are in the vicinity of Sandy Hook, Barnegat Inlet, Little Egg Inlet, and Cape May. At each area a rectangular grid was aid out, the spacing between exploration lines was one statute mile. Inspection of the geophysical records and knowledge of the geology and the shore processes were the basis for determining the location of core sites. By the end of October 1964 the contractor had completed all of the work, some 1,500 miles of exploration lines and approximately 200 borings.

A similar increment of work is presently nearing completion. Operations started on January 6, 1965 in the vicinity of Cape Florida and have progressed to Cape Kennedy, the northern limit of the area. Over 100 cores and 1,000 miles of exploration lines have been completed at this time. It is most interesting to note that Cape Kennedy and the shoals adjacent thereto appear to be controlled by structure. The geophysical records show a broad, roughly north-south arching at depths of about 3 to 400 feet below water surface.

DISCUSSION

Question: What analyses are made on the sediments?

Answer: We are committed to do size-distribution analyses in order to determine whether the material is satisfactory for beach use. The Florida samples will probably be analyzed for calcium carbonate content also. We are most interested, however, in seeing further analyses made.

Question: In general, how far offshore do you operate?

Answer: Operations have been conducted as much as 30 miles from shore.

Question: Do you consider a source 30 miles from shore to be economic?

Answer: If there were no closer source it might be, but generally this would be most questionable.

Question: Does the coring frame move up and down with the ship motion?

Answer: No. The 18-foot long frame has four legs which support it on the bottom and the rig is connected to the boat by three flexible rubber hoses and a wire rope. For this reason it is unnecessary to maintain the vessel directly over the site. It is necessary, however, to maneuver the boat directly over the rig and pull-out in order to prevent bending the core barrel.

Question: Is the Vibracorer more efficient than free-fall corers?

Answer: Very much so. Free-fall corers penetrate one or perhaps two feet. The Vibracorer penetrates 10, 12, or 15 feet of sandy sediments.

Question: Have you been able to correlate sand deposits with your cores and with geomorphic forms, particularly the elongate shoals that exist up and down the coast?

Answer: Both your questions are very interesting for very practical reasons. A fairly detailed survey of these elongate shoals was made in the vicinity of Manasquan, New Jersey. The shoal is relatively coarse sand. The Corps of Engineers is planning a full systems test in this area; picking up the material and putting it onshore. The test area contains 40 plus million cubic yards of sand - ideally suitable sand.

Question: Is this a topographic ridge?

Answer: Yes.

Question: Are the cores available for analysis by other laboratories?

Answer: We would be very interested in having further discussions along

these lines with the universities that have indicated an interest, and with other Federal agencies which have similar requirements.

Question: Does the sand drop out of the core barrel as the tool is being retrieved?

Answer: This difficulty existed and may still exist. Losses may occur as the core barrel is being pulled from the bottom notwithstanding the presence of a core catcher and a cloth wrap-around to help the core catcher. We don't know how to check this. Once the core barrel is out of the bottom, the opening is closed off by a metal plate which prevents any loss of material. The problem has been identified by the penetrameter which may indicate 12 feet of penetration and the core recovery may be only 6 or 8 feet, depending upon sediment type. Less core is recovered in carbonate sediments than in silica sediments. Because the driving force is vibratory, compaction is expected but how much is unknown.

MARINE GEOLOGY IN THE OFFICE OF OCEANOGRAPHY

by

Richard J. Malloy
Office of Oceanography
U. S. Coast and Geodetic Survey

The Office of Oceanography pursues studies of marine geology through the utilization of standard techniques and instruments, some of the methods are: hydrography, continuous seismic profiling, gravimetric and magnetic measurements, bottom photography, bottom sampling, heat probe, and tide data. Two important omissions are seismic refraction and the lack of land mapping to project the data to the marine environment. It is known now that the Continental Shelf is similar in characteristics to the subaerial Coastal Plain.

The Office of Oceanography has three Sparker instruments with a power range of 250 joules to 20,000 joules. A new sound source, the air gun, is proving of major interest primarily because of its simplicity and efficiency. Another instrument, yet to be tested, is a signal correlating device designed to analyze the air gun's outgoing signal and the returning signals, rejecting mismatches, or random noise. If the test is successful (and it is expected to be), it will be possible to do more seismic profiling at the same time hydrographic surveys are made.

As an example, detailed seismic profiling and magnetic surveys were completed along with hydrography in the Gulf of Maine in 1962. The map shows strong northeast-southwest lineation which, according to very strong evidence from our magnetic surveys is caused by regional structure. The data illustrate a basin with Triassic sediments flanked by swarms of dikes, including a large ring dike. Four maps have been prepared including bathymetry, total magnetic field, and bedrock morphology, and an isopachous map of the thickness of recent sediments overlying the polished basement floor. From these data it is possible to classify the area as an extension of the Appalachian physiographic province, strong ridge and trough topography.

By virtue of the fact that the Coast Survey does detailed hydrographic studies, it is in a unique position to do detailed seismic profiling. Another instrument, the side-looking sonar, promises to be an aid in mapping the sea floor in greater detail, possibly in three dimensions. Finally, we are digitizing the magnetic and gravity data already collected in order to make the data available in tabulated form, and in machine printed cross-sections, as well as by contour maps.

DISCUSSION

Question: What resolution do you expect with the signal correlator?

Answer: About a foot or two.

CONTINENTAL SHELF MARINE GEOLOGY IN THE OFFICE OF RESEARCH AND DEVELOPMENT

by

J. W. Kofoed
Office of Research and Development
U. S. Coast and Geodetic Survey

The Office of Research and Development of the Coast and Geodetic Survey has the responsibility for conducting research, and overseeing research in other offices of the Survey. These activities include research in geomagnetism, geodesy, gravity, geophysics, seismology, photogrammetry, cartography, and, of course, oceanography. The comments here will be concerned with the oceanographic research.

The oceanographic research program is carried on under a project system of which there are presently nine. Of these, seven are related in whole or in part to the Continental Shelf. A brief description of the objectives of these projects is given below.

1. Estuarine Studies - This project is presently located at the Joint Oceanographic Research Group in Seattle, Washington. The primary objectives of this project are: to develop the means to provide adequate information on the mean- or net-circulation of estuarine systems, as may be required to give sound guidelines for the design and planning of municipal and industrial systems and processes that utilize the estuary as a means of waste disposal; to develop means for forecasting recurrent or periodic departures from the mean- or net-circulation identified above; and to develop means for providing short-term forecasts of nonperiodic departures from "normal" conditions, which could cause undesirable effects if "normal" utilization of the estuary were to continue during the period. All the activities and research associated with this project can readily be included and/or related to the Continental Shelf research.

2. Continental Shelf Physiography - The research associated with this project is related entirely to the Continental Shelf. The objectives of this project are to describe the morphology of the Continental Shelves; to interpret the effects of sedimentary and tectonic processes on the Continental Shelf morphology; to predict morphological changes on the Continental Shelves; to disseminate morphological data and geological interpretations for scientific use, and to conduct environmental and economic exploration and exploitation of the Continental Shelves.

This project is intended to be of a long-term and continuing nature designed to coordinate these vital research activities with the Survey's activities in oceanography and nautical charting.

3. Deep Sea-Floor Research - Investigation and subsequent evaluation of continental-drift theory is the principal objective of this project.

Aspects of this project related to the Continental Shelves are the study of continental margin prisms, their formation, collapse and structure, continental accretion, and the character of the ocean floor.

4. Environment and Structure of the North Pacific - This project, presently located at the Joint Oceanographic Research Group in Seattle, Washington, is currently being pursued on a very limited scale and is being revised in terms of objectives and scope of activities. It is suggested that at least half of the activities of this project will be related to the physical oceanography and geophysics of the Continental Shelf.

5. Marine Geophysics - Approximately half of this research project is directed toward Continental Shelf activities. The objectives are to study the growth of continental accretion, relationship of the continental margins to continental drift and expansion of the earth, and continental margin tectonics.

6. Physical Oceanography and Sedimentation - This project is currently being totally revised. The new objectives will be directed toward the investigation of the nature of interfaces in space and time variations of thermal patterns; development of techniques and instrumentation for measuring the properties and patterns of the interface on a variety of spatial and temporal scales; showing the cause and effect of interface properties to environment; using the Gulf Stream as an experimental model; determining on a problem-oriented basis the interrelationships of temperature patterns with other oceanographic phenomena; development of prediction criteria for temperature and interrelated events; and to explore means for controlling aspects of temperature distribution.

7. Land and Sea Interaction Laboratory - Primarily, this project is designed to provide fundamental information on the response of beaches, estuarine and continental-shelf sediments to applied static and dynamic forces and to predict these responses. This is to be accomplished by the development of the process-response mechanisms in the natural environment; by the formulation of prediction equations for observed land-sea interactions; and by verification of predictor equations by long-term environmental studies. This project will ultimately provide a series of equations to predict the behavior of all types of sediments under natural and artificial loads and to provide a comprehensive, automated, and computerized data acquisition and analysis system providing 24-hour forecasts of wind, wave, tide, current, and storm-surge effects on beaches and estuarine and continental-shelf sediments.

This is a summary of the Survey's activities on the Continental Shelf and obviously all these oceanographic research projects are interrelated and go together to make up our research program. These studies are also of benefit to much of the geophysical research carried on in the Survey.

We would welcome the opportunity at any time of discussing any or all of these projects with anyone who is interested in our research program.

LAND AND SEA INTERACTION LABORATORY

by

Wyman Harrison
Office of Research and Development
U. S. Coast and Geodetic Survey

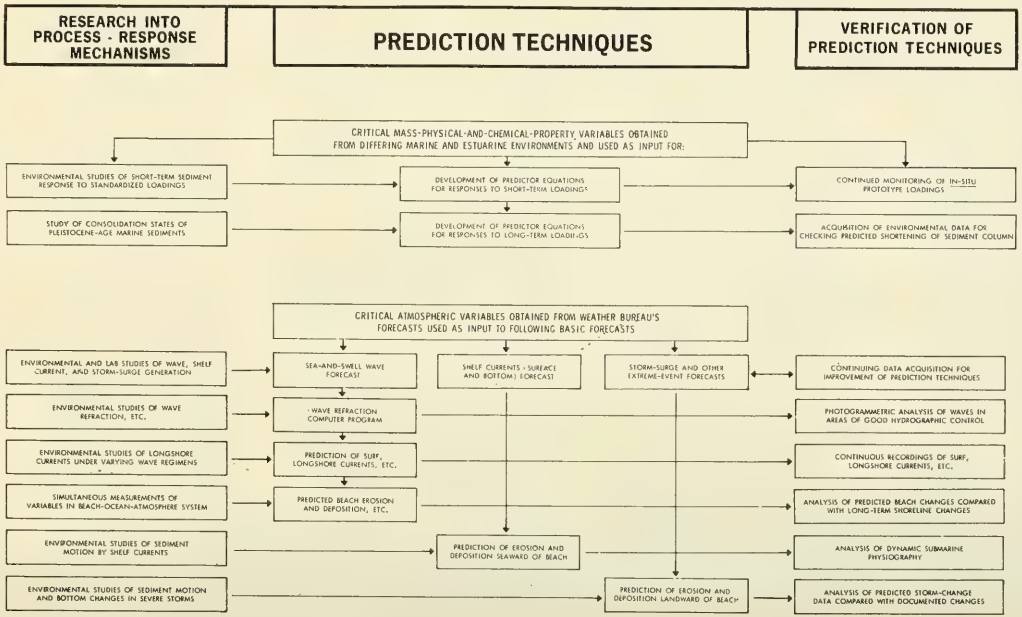
Since Dr. Harrison was unable to be present, Mr. Kofoed distributed the following sheet concerning the laboratory.

U. S. DEPARTMENT OF COMMERCE
COAST AND GEODETIC SURVEY
OFFICE OF RESEARCH AND DEVELOPMENT

LAND AND SEA INTERACTION LABORATORY

Mission. ADVANCED AND EXPLORATORY RESEARCH ON THE RESPONSE OF BEACHES AND ESTUARINE AND CONTINENTAL SHELF SEDIMENTS TO APPLIED STATIC AND DYNAMIC FORCES

FLOW OF EFFORT RELATIVE TO THE THREE MAJOR ASPECTS OF THE RESEARCH AND DEVELOPMENT STUDIES AT LASIL



APPLICATIONS

CONTRIBUTIONS OF THE LAND AND SEA INTERACTION LABORATORY *LASIL* WILL AUGMENT THE FUND OF BASIC INFORMATION NEEDED FOR SCIENTIFIC, ENGINEERING, AND NAVIGATIONAL PURPOSES. *LASIL* WILL IMPROVE THE EFFICIENCY AND EFFECTIVENESS OF THE COAST AND GEODETIC SURVEY BY PROVIDING

I. FUNDAMENTAL INFORMATION ON THE NATURAL STATE AND LOADING MECHANICS OF THE GAS-FLUID-SOLID SYSTEM OF THE SEA FLOOR
II. HIGH-SPEED TECHNIQUES FOR THE PREDICTION OF THE EFFECTS OF WAVES, TIDES, CURRENTS, AND STORM SURGES ON BEACHES AND CONTINENTAL SHELVES.
III. GUIDANCE TO PROGRAM PLANNING IN RELATED AREAS OF RESEARCH AND OPERATIONS.

LASIL IS LOCATED IN THE NORFOLK REGIONAL OFFICE, COAST AND GEODETIC SURVEY, 439 YORK STREET, NORFOLK, VIRGINIA 23510 (DR. W. HARRISON, CHIEF)

CONTINENTAL SHELF PROGRAMS OF THE U.S. NAVAL OCEANOGRAPHIC OFFICE

by

Robert Winokur
Oceanographer, U. S. Naval
Oceanographic Office

Captain Treadwell had hoped to be here to make this presentation; however, he regrets that he is unable to attend and sends his apology.

The U.S. Naval Oceanographic Office has an interest in all information concerning the geology of the ocean bottom, in both shallow and deep water. Most of the geology and sedimentation programs at the Oceanographic Office concern deep-water areas, although a few do involve shallow-water areas as discussed below.

A Ship-of-Opportunity Program, operating intermittently in the Middle and Far East during the past eight years, has resulted in the collection of approximately 700 bottom samples. These include grab samples, Kullenberg cores, and Phleger cores. The areas include the Gulf of Siam, Straits of Malacca, Andaman Sea on the west coast of Thailand, Nicobar Island area, Persian Gulf, and the Arabian Sea. These cruises have been cooperative ventures with the countries involved. Future plans include work in the Bay of Bengal, northern Andaman Sea, and the East Indies.

An Arctic Survey Program, in cooperation with the University of Washington, has resulted in the collection of a large number of bottom samples, particularly in the Bering and Chukchi Seas. Under this program the samples are analyzed for chemical and mechanical properties by the University while Oceanographic Office personnel make mineralogic analyses. The University is granted the privilege of utilizing the samples for thesis research and this type of cooperation permits them to obtain National Science Foundation funds to support some of the analysis effort. Future plans include sampling in the Barents, Laptev, and East Siberian Seas.

A third shallow-water program is in conjunction with the Atlantic Undersea Test and Evaluation Center (AUTEC) in the Tongue of the Ocean. During May 1964 a survey of the ocean bottom was made off the eastern shore of Andros Island. Detailed bathymetric data, approximately 1,900 feet of underwater 16-mm. movie film, and several hundred underwater still photographs were taken by divers. In addition, bottom samples were collected and analyzed for size distribution and constituent grains. Additional surveys are planned for the same general area this year and include the use of a Perry Cubmarine to follow the outer slope of the seaward platform down to a depth of 600 feet.

During 1962 a continuing study of the eastern Grand Bahama Bank began and a report of the geological sampling of this area is in preparation.

The report includes data on 150 grab samples which have been analyzed for size distribution, carbonate content, organic carbon, and grain constituents. Future work includes a study of the shallow-water environment in the vicinity of Exuma Sound.

Sonoprobe surveys have been made in Penobscot Bay, Maine, and between Cape Charles and Cape Henry, Virginia. A report concerning the work in Maine was published in April 1965. Results of other, less extensive, shallow-water programs (both domestic and foreign) are unpublished, but much of these data are unclassified and are available for study.

An additional program of interest is the Nearshore Environmental Prediction System Project. The intent is to predict unknown nearshore oceanographic conditions, such as bottom materials, by inference from known environmental conditions, which include the geomorphology, oceanography, and climatology of the area in general. All available data are compiled and examined with the aid of an IBM 7074 computer to find any relationships which may exist. Preliminary results, however, are not promising.

Finally, the Oceanographic Office has on file the results of the analyses of over 38,000 bottom samples which have been collected around the world by many different organizations. Of these, over 30,000 are surface samples and about 8,000 are core samples. Approximately 60 percent of the total are Continental Shelf samples. These data are used to compile bottom material charts produced by the Oceanographic Office. Also, NAVOCEANO Technical Report No. 150 presents charts illustrating the world-wide distribution of data on file at the Naval Oceanographic Office.

DISCUSSION

Question: Does the Environmental Prediction Program attempt to analyze the relationship between onshore geomorphology, bathymetry, and so on with a computer?

Answer: Yes, the Program utilizes coastal morphology and bathymetry in searching for a relationship concerning nearshore bottom textural characteristics. Additional inputs include the climatology and oceanographic environment as it may effect sediment distribution.

SUMMARY OF SHALLOW-WATER GEOLOGY AND GEOPHYSICS PROGRAMS SUPPORTED BY OFFICE OF NAVAL RESEARCH

by

H. J. McLellan
Earth Sciences Division
Office of Naval Research

The Office of Naval Research (ONR) supports research programs which eventually may be of value to the Navy. The research programs necessary for the solution of Navy problems of immediate importance are handled by other organizations within the Navy.

ONR-sponsored research is done, in the main, at universities and independent laboratories, although some of the work is being done in industry. It is our intent, in all cases, to permit and nurture studies unhampered by continuous control. Because of this approach, we are not cognizant of all of the details. This report is, therefore, a broad-brush treatment of ONR-sponsored research pertinent to today's discussion. It should be pointed out that the National Science Foundation also supports a number of the same institutions and people for the same type of work, and, at times, identical projects.

At the University of Washington, J. S. Creager and M. G. Gross, in cooperation with the U.S. Navy Oceanographic Office, are investigating the geology of the Continental Shelves of the Laptev, East Siberian, Chukchi and Bering Seas. Former shore lines are being traced; research techniques involve coring, seismic reflection, bathymetry, texture, forams, mineralogy and sound propagation parameters. They are also studying sediments and radioactivity of the Columbia River.

M. Rattray is studying bathymetric effects on ocean currents, and internal wave studies in the field and the laboratory.

J. S. Creager heads a group analyzing sediment and its transport mechanisms on the Continental Shelves. Current profiles, suspended sediment and its transport, characteristics and geometry of sediments are all observed simultaneously with a television camera fixed above the bottom.

At Oregon State University, John Byrne, LaVerne D. Kulm and Gerald A. Fowler are engaged in a program which includes the following projects:

1. Studies of coastal erosion along the Oregon coast where the process is extremely active.

2. Determining the source of sediments which are transported in the littoral zone and tracing their migration by textural and mineralogical analyses to beaches, dunes and terrace deposits in the region from northern California to central Washington.

3. Sedimentation in estuaries - texture and foraminiferal assemblages related to estuary circulation and hydrography.

4. Astoria Fan and Astoria Submarine Canyon - structure sediments composition and processes.

At the Scripps Institution of Oceanography, J. R. Curray, in association with D. Moore of the U. S. Navy Electronics Laboratory (NEL) is working on the following projects: continuing the study of structure, sediments, quaternary history and origin of the continental terrace - as a world-wide feature. Extensive work is being done at present on the coasts of California and Mexico.

F. P. Shepard is continuing investigation of submarine canyons and associated phenomena - Bahamas, Cape San Lucas, La Jolla, Scripps and Baja California.

D. L. Inman is engaged in several projects - mechanics of sedimentation by waves, currents and winds (fluid mechanics), continuing a study of processes in Scripps Canyon, and shoreward migration of beach sands as traveling dunes.

E. W. Fager is studying shallow-water benthic communities and their role in stabilizing sand bottoms.

At Texas A&M University, a group, working with R. D. Gaul, operate instrumented towers off Panama City, Florida, for continuous observation of currents, waves, and other phenomena. Associated projects involve waves and their modification, sediment transport, and coastal currents.

R. O. Reid is investigating the influence of bottom topography on coastal currents near the Mississippi Delta and Apalachicola Bay.

John W. Antoine, using reflection and refraction techniques, is making an intensive study of the geophysical structure of the Gulf and Caribbean. Early concentration was on the east Gulf Shelf and the study is now progressing westward.

W. R. Bryant is conducting an investigation of the stratigraphy, mineralogy and mass properties of sediments from the Mississippi River.

At the Lamont Geological Observatory, M. Ewing and associates are engaged in an extensive world-wide study of structure and sediments - not easy to localize on any region of the North American coast.

At the University of Miami, E. D. Traganza is working on a detailed, continuing study of the chemistry of environment relating to carbonate deposition on the Bahama Banks.

R. J. Hurley is studying the topography and subbottom structure in the Straits of Florida and in the Bahama region, including a submarine canyon in New Providence Channel.

At the Woods Hole Oceanographic Institution, John M. Zeigler and W. D. Athearn are investigating velocity fields within breaking waves, sand movement and generating of sand ripples under shoaling wave action, and nearshore hydrodynamics and sand movement. Comparison is being made between beaches on the east and west coasts.

R. Pratt and K. O. Emery, who is supported by another source, are analyzing gravels and collecting bottom current measurements from the Gulf of Maine, studying the terrigenous boundary on the Blake Plateau, and investigating the basic division of the sedimentary regime off the East Coast.

At the University of Rhode Island, R. L. McMaster is studying sedimentation patterns on coastal shelves.

DISCUSSION

Question: Who retains title to samples obtained under ONR-sponsored research?

Answer: The contractor retains title.

Question: Are the analytical results sent to the National Oceanographic Data Center?

Answer: We expect the data to be published and made available to others. Most of these people are eager to publish, although some journals will not accept tabulated data. The contractor is encouraged to submit this data to NODC.

SUMMATION OF RESEARCH ON THE CONTINENTAL SHELF SUPPORTED BY THE NATIONAL SCIENCE FOUNDATION

by

R. G. Bader
Earth Sciences Section
National Science Foundation

The National Science Foundation (NSF) supports studies on the geology and sediments of the Continental Shelves. There are some 25 grants that represent in the order of 15 percent of the funds budgeted for oceanography. Studies are supported at the following universities and oceanographic institutions: University of Chicago, University of Georgia, University of Miami, University of Alaska, University of Washington, Oregon State University, Scripps Institution of Oceanography, Woods Hole Oceanographic Institution, Lamont Geological Observatory, and the Geological Survey of Israel. Studies are in progress concerning the physiography of the continental terrace, littoral drift, littoral currents, dynamics of sediment transport, subbottom profiling, coral reefs, submarine canyons and sediment distribution patterns, along the coasts and especially in the vicinity of estuaries.

The Institute of Marine Science of the University of Georgia is primarily concerned with the bays and the offshore bottom adjacent to the Georgia shore. They are attempting to determine the effect of river sediments on the Continental Shelf, the dispersion patterns of the river sediments, and whether a seasonal variation in sedimentation exists. The University of Alaska is studying the effects of glaciation of the Continental Shelf and sedimentation in inland waterways.

The Geological Survey of Israel is involved in a study of the bathymetry, the petrology, and the distribution of the sediments on the shelf off Israel. They have done a significant amount of work on the land and the coastal area and are extending this to the offshore area. The offshore area has been found to contain old dunes and other similar coastal geomorphic forms. The submergence of the offshore area may have been caused by subsidence of the land mass, the glacio-eustatic rise in sea level, or by a combination of both.

Another National Science Foundation program is scheduled to start in 1966 and involves long ocean-sediment coring. Cores are to be taken from the Continental Shelf, Continental Slope, coral reefs and possibly as far as the basement stratum of the deep ocean. Through a combination of fortuitous circumstances the program was started this year when it became possible to lease a drilling vessel and pay only for the drilling time, equipment insurance, and costs of this sort, but no mobilization and demobilization costs. At this time, four cores from 200 to 900 feet in length have been obtained. Core recovery has been about 70-75 percent. Cores have been, or will be, taken on the Blake Plateau and other parts of the Continental Shelf. A continuation of this program should lead to a resolution of

some of the complex problems concerning the structure and sedimentology of the Continental Shelf.

Manpower is another facet of the problem. This type of program should cause a number of geologists and engineers to become involved in the marine area of study and they will be needed. The number of trained petrologists, micropaleontologists, and scientists in associated disciplines, working in the marine sciences at present are unable to cope with the number of samples being procured. However, the advent of long, undisturbed cores taken on the shelf and the deep ocean should bring additional, badly needed manpower into the discipline. The long cores make possible studies concerning environmental cycles and other cyclical phenomena.

Much of our shelf work cannot be separated from deep ocean studies. In many instances the work is done by the same people who either extend their deep ocean work onto the shelf or who, while near a given location, devote some time to a shelf study. Work being done by Scripps Institution is an example of the former and the University of Miami does the latter.

A number of inquiries have been made by smaller institutions who are interested in working in the marine sciences. Inasmuch as the larger institutions work extensively in deep water, it would be well for the new, smaller institutions to consider the Continental Shelves, shore lines and estuaries. Studies concerning sediment transportation, flushing of estuaries, tidal currents, biology of the shallow-water fauna and flora should prove most rewarding. This should be an area in which these institutions can make a major contribution.

DISCUSSION

Question: Who will own the long cores and where will they be stored?

Answer: This operation is being conducted by Joint Oceanographic Institutions Deep Earth Sampling (JOIDES) through the Lamont Geological Observatory, a member institution. One-half of the cores will be stored at the University of Miami and the other half will be sent to the Smithsonian Institution.

Question: On what basis does NSF support research by foreign agencies - I thought all money went to national institutions?

Answer: There are NSF grants in Chile, Nigeria, Congo, Peru, Brazil, Equador, Scotland, Canada, Japan, and Israel. The method is somewhat different from normal grants. One such method involved the existence of an international agreement. Another is to fund important scientific programs when no American organization is interested in doing the work or none is available to do it. An example of the latter case involves a second grant in Israel which concerns a computer study of the real oceans. The physical oceanographers agreed that a more satisfactory model had to be achieved and so the work was justified.

MARINE MINERALS MINING TECHNOLOGY

by

G. Richards Gwinn
Mineral Resources Development, Bureau of Mines
U. S. Department of The Interior

The marine minerals technology program is addressed to the single purpose of devising and perfecting systems for the development and mining of mineral substances on and below the ocean's floor. It is an applied program in marine engineering adapting known principles to an undersea environment and designed to demonstrate the economics as well as technologic feasibility of commercially extracting minerals from the sea. The program was initiated in fiscal year 1964 and, following an initial period of project formulation study, entered an actual operational stage in 1965.

Working with the Bureau under a cooperative agreement are the Lockheed Missiles and Space Company and the International Minerals and Chemicals Corporation.

The present and projected plan of operation contemplates a cooperative venture joining the skills of private and government organizations in a variety of arrangements that promise to achieve the goal of commercial production in the most direct and logical fashion. It is an in-house Federal program backstopped by the established research facilities and capabilities of the Bureau of Mines as well as the other agencies and private industry groups cooperating in the program. A large share of the funding is provided by the private interests that are cooperating in the work.

An inactive Naval Station at Tiburon, California, is the land-based staging site for aspects of the program that are conducted at sea and on the ocean bottom. It is the principal base of operation for the ships and submersibles employed in support of such work. It will ultimately accomodate a central data processing and communication establishment and laboratory facilities for mineralogical investigations not otherwise performed at some inland establishment. Shop facilities adequate for emergency repairs and simple modification,and instrument fabrication and repair are maintained there. Major construction is accomplished elsewhere.

Several engineering projects are now accommodated under the program, all concerned with some aspect of gathering and recovering mineral substances. The projects relate to the application of hydraulic and airlifting systems and to a variety of accessory devices designed to sample and understand the nature of the occurrences to be mined. Consideration of economic factors dictates that initial concern be directed to the shallower forms of mineralization on the Continental Shelf at locations where markets are conceivable. Investigations will progress to the depths and expand in scale and scope on the basis of experience, findings, and degree of success of the initial program.

The Bureau's Marine Mineral Technology Center has made exceptional use of Government excess property for the outfitting and operation of the two mining research platforms. Many valuable items such as line, fenders, pumps, hose, navigational instruments, tools, and the like have been made available through other Government agencies at no charge. A classic example of this is the procurement of $225,000 worth of stainless steel cable from Navy surplus which is invaluable for lowering mineral recovery hardware to the sea floor.

Private industry also has assisted the Federal Government to establish a sea-going capability in ocean mining. Oceanographic Engineering Corporation loaned the Bureau $15,000 in instruments and gear. The Raytheon Corporation provided navigational and safety devices at cost plus five percent and the University of Washington loaned the Bureau other items of marine equipment. The U. S. Rubber Company supplied the marine mineral technology group with 100 feet of special purpose rubber hose, worth several thousand dollars, for use on shipboard to develop an airlift mining system.

Through such cooperation of Federal and State organizations, institutes, and private industry, the Bureau has been able to establish an active marine mineral engineering program at a fraction of the cost which might be expected.

CONTINENTAL SHELF PROGRAM OF THE GEOLOGICAL SURVEY

by

Gilbert Corwin
Marine Geology and Hydrology
Geological Survey, U. S. Department of The Interior

A major goal of the Department of the Interior is the determination, evaluation, development, and conservation of the Nation's natural resources. This morning Mr. Barry spoke on the Department's responsibilities for offshore leasing and the supervision of development and conservation of mineral resources on the Continental Shelves; Mr. Gwinn presented data on mineral development and exploitation. The Geological Survey has the mission of determining and evaluating the Nation's mineral resources. It is also responsible for classifying the mineral resources, including potable water, of the public lands of the United States, which include the outer Continental Shelf beyond the limits of State ownership. A small group within the Survey has responsibility for regulating development and conservation of these offshore mineral resources.

Objectives of the Geological Survey's marine program are to locate and evaluate mineral resources on and beneath the ocean floor, to extend seaward our three dimensional knowledge of the land, and to gain information needed for use in the search for resources on land, many of which were formed beneath ancient seas. Initially emphasis of the program is on the Continental Shelves and Slopes bordering the United States. We divide the Continental Shelves and Slopes into five regions: 1. the Atlantic; 2. the Gulf; 3. the Pacific from Mexico to the Canadian border; 4. Alaska; and 5. Hawaii and all possessions and territories. Up to now effort has been concentrated on a joint study of the Atlantic margin with the Woods Hole Oceanographic Institution, the Bureau of Commercial Fisheries and other organizations; modest efforts are underway along other coasts.

The Atlantic program illustrates our approach to the study of offshore areas. The Atlantic Continental Shelf and Slope was picked as the first area for study, because, oddly enough, less was known about it than about most others. Academic institutions have done a great deal of exploration off the coasts of southern California, Washington, and Oregon, some of which has been supported by Office of Naval Research and the National Science Foundation. Petroleum exploration along the Gulf Coast has provided much information concerning that area. Universities such as Texas A&M, have made other contributions along that coast.

The first requirement for mapping resources is a base map. On land, the U. S. Coast and Geodetic Survey provides the geodetic control and the Geological Survey does the mapping. Along the coasts and on the shelf the Coast Survey has the responsibility of charting relief of the ocean floor. Therefore, the first effort within the Atlantic program was to produce base maps from charts compiled by the Coast Survey, and, in areas where

their data was scant or lacking, from other sources, such as Woods Hole Oceanographic Institution, Lamont Geological Observatory, the University of Miami, and the Canadian Hydrographic Office. Other sources, as the Bureau of Commercial Fisheries, and the petroleum companies, produce comparable base maps to meet their own special needs; those of industry are excellent but, unfortunately, not generally available. Preparation of the 3-sheet base map, which shows the general bathymetric setting, involved cooperation of the Woods Hole Oceanographic Institution, the Office of Naval Research and others, has been completed. (Published during mid-October 1965.)

As the base maps were being compiled, laboratories were prepared, preliminary analyses of the physiography were made, and a reconnaissance survey of surfacial sediments was initiated. For sampling of the surficial material, K. O. Emery of Woods Hole and director of the program, developed a grid pattern with spacing of 18 kilometers, roughly 10 nautical miles. Sampling stations were taken at grid intersections points. The Bureau of Commercial Fisheries provided samples which they had collected within the Gulf of Maine; sampling of surficial sediments throughout the rest of the area, from Nova Scotia to Key West, Florida, has been essentially completed.

Geophysical cruises (sparker and fathometer) have been interspersed with the sediment-sampling cruises. Earlier geophysical information was scattered and thus an effort is being made to obtain a total picture.

The sediment and geophysical phases are being performed first in order to obtain information that can be used to most effectively carry out studies of the underlying rocks. This phase, which has just begun, involves coring, dredging, and drilling in areas where rocks crop out at the surface or where the surficial sediments are thin.

The Geological Survey, through its association with Woods Hole, is cooperating in the Joint Oceanographic Institutions Deep Earth Sampling (JOIDES) Blake Plateau drilling program. The objective is part of the lithology phase of our overall program. We are interested, of course, in the structure of the shelf as it will be revealed by the JOIDES cores. Relative to the JOIDES cores, some data has been released to the newspapers. A USGS man aboard the drilling vessel identified two aquifers that were penetrated in borehole J-1, 30 kilometers east of Jacksonville and found that both were of artesian nature. In fact, the hydrostatic pressure was much greater than had been anticipated.

The above is an outline of our approach to the mission with which we are charged. It seems appropriate to remark that there is much to be done by each of our organizations and there are many opportunities for us to cooperate. Our present arrangement with the Bureau of Commercial Fisheries to determine relations between sessil marine organisms and the sediments on which they live is an example of many that might be cited.

Of great interest to the Corps of Engineers' activities is our delineation of a gravel deposit offshore from New Jersey. It is our feeling that the publication about the gravel deposit should create considerable interest in industry. It is also interesting to note that the gravel appears to be associated with a former, possibly Pleistocene, drainage channel of the Hudson River. This, then, is another example illustrating that the offshore is a continuation of the same geology known above sea level.

DISCUSSION

Question: Are you limiting exploration to the Shelf area only?

Answer: Work is starting on the Shelf because that is where the greatest amount of information is available. To answer in another fashion, the Shelf is being studied because (a) it is close by and therefore accessible, (b) there is a firm foundation of knowledge of the land which may be extended seaward, and (c) more information is available concerning the Shelf than is known about deep ocean areas. Studies will be made later of areas further from shore.

THE ATOMIC ENERGY COMMISSION PROGRAM IN THE MARINE SCIENCES

by

Arnold Joseph
Marine Scientist
U. S. Atomic Energy Commission

The Atomic Energy Commission (AEC) program in the marine sciences is mission oriented. The mission has three parts: (a) to develop data which establish levels of radioactivity which would be safe in the marine environment; (b) to understand the marine environment well enough to permit design of radioactive devices that will not present a hazard to the health and safety of the public; and (c) to utilize radioactive tools to increase man's understanding of natural phenomena. Two examples illustrate the kind of work under AEC's mission - one has to do with aerospace applications and the other with a land-based nuclear reactor operation.

Systems Nuclear Auxiliary Power devices and/or nuclear-powered reactors are likely to be used on space vehicles in the future. If an accident were to occur, and it is possible, the nuclear device could be introduced into a marine environment. Under these conditions a nuclear excursion is possible, and the radioactive material could be dispersed as a spectrum of large and small particles. Therefore, AEC is concerned with predicting the time space distribution of the pieces and their possible effects on the environment. As basic input to this problem, studies have been made in cooperation with the Bureau of Commercial Fisheries on the fish and fisheries within a 40-mile radius of the launch pads on both the East and West Coasts. Studies have been completed on the physical diffusion characteristics of the areas. Other studies in progress cover the meteorology and ground water hydrology of the area. A study has just begun in which the University of Florida is to simulate reactor debris, place the tracer material on the bottom and determine its redistribution pattern and rate of translocation. The simulated debris here is crushed concrete made to size and density and impregnated with fluorescent material in order that it may be detected. A possible problem is that the fluorescent tag does not decay, and there is a possibility of a later test being contaminated by material from an earlier test. However, 26 colors to choose from alleviate the problem somewhat. In the University of Florida project, material ranging in size from 100 to 2,000 microns will be deposited on the bottom. Surface samples are passed under a spectrofluorometer, where the number of each type of tagged grain will be counted.

The second example of work related to coastal engineering involves the University of Washington and the Hanford reactor operations. A group at the University is studying the sediments being transported by the Columbia River to deep water off the coast. An instrument has been developed which can observe and measure water velocity in profile, and take samples of water and sediments to determine the quantity and characteristics of the sediments being transported.

In other parts of the AEC marine sciences program indirectly related to coastal engineering work, studies are supported which concern the chemistry and radiochemistry of particulate material and material in solution in the oceans. Some of this involves trace elements. Other studies are concerned with geochronology, i.e., determining the age of sediments through the known decay rates of certain natural heavy element radioisotopes.

THE BUREAU OF COMMERCIAL FISHERIES INTERESTS IN CONTINENTAL SHELF MORPHOLOGY AND COASTAL SEDIMENTS

by

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For nearly a century the U. S. Bureau of Commercial Fisheries (formerly known as the U. S. Fish Commission) has had a strong interest in the topography and bottom sediments of the Atlantic Continental Shelf. This interest is centered primarily on two aspects: (1) The ecological relationships between marine organisms, particularly finfish and shellfish, and the various types of substrates; and (2) the delineation of areas where water depths and substrates are suitable for conventional commercial fishing.

Some of the Bureau's research projects that pertain to Atlantic Shelf morphology and sediments are as follows:

1. A cooperative investigation with the Woods Hole Oceanographic Institution and U. S. Geological Survey is now in progress to determine the interrelationships between the benthic fauna and bottom sediments. This study includes the analysis of approximately 2,000 samples collected from the Atlantic Continental Shelf between Nova Scotia and Key West, Florida.

2. Collection and general analysis of 500 surface sediment samples from the Continental Shelf region between the Bay of Fundy and Hudson Canyon. Some of these samples are also being analyzed for Clostridium botulinum by bacteriologists at the Massachusetts Institute of Technology.

3. A topographic model (4 feet by 9 feet) of the New England Continental Shelf and Slope has been constructed and will soon be completed.

4. Animal remains, such as mollusk shells, fish otoliths, cirriped plates, echinoid tests, etc., from a suite of 175 surface sediment samples collected from the Continental Shelf south of Cape Cod, Massachusetts, are currently being analyzed.

ENVIRONMENTAL OCEANOGRAPHIC RESEARCH PROGRAM OF THE BUREAU OF COMMERCIAL FISHERIES

by

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U. S. Bureau of Commercial Fisheries

Objectives of the program are: 1) to develop methods for describing, explaining, and predicting the geographic distributions and abundances of marine organisms, and their changes in time, and 2) to define the potential of particular species as indicators of environmental oceanographic conditions. Emphasis is on sedentary and sessile bottom dwelling forms on the Continental Shelf of the western North Atlantic. For the most part existing data only are used. Three major research projects are currently in operation.

1. Mapping of the geographic distributions of selected marine species.

2. Detailed environmental mapping - sufficiently comprehensive geographic data exist only for temperature, bathymetry and sediments.

a. Mapping of bottom temperature parameters such as variance, range, extreme values, and durations.

b. Topographic mapping of the Middle Atlantic Continental Shelf (from Veatch Canyon to Baltimore Canyon) is about 80 percent complete. It is at a scale of 1:125,000 with a contour interval of one fathom.

c. Bottom sediment (bottom type) overlays to the above topographic map are in preparation.

3. Cape Cod field study. Periodic samples of the bottom fauna (including some sediment samples) have been taken since the summer of 1962 along a transect running from Cape Cod Light at Highlands to the 50-fathom isobath. The bottom temperature-pressure environment along the same transect has been monitored since the spring of 1965 by recording instruments installed in buoys in cooperation with the U. S. Coast Guard.

THE NATIONAL OCEANOGRAPHIC DATA CENTER

by

Martin Weiss
Chief, Geoscience Branch
The National Oceanographic Data Center
U. S. Department of the Navy

The papers given today are a slight indication of the amount of data being generated in the field of oceanography, and a real danger exists that some of the data will be overlooked. If this were to occur, a great deal of expensive and laborious work may be duplicated. This, then, is the mission of the Data Center, to archive and make available to others the data which have been collected.

We have been handling bathythermograph and other physical oceanographic data for several years. More recently a program for core, grab, and dredge samples has been completed. A manual has been prepared and, although some changes are contemplated, it is a viable instrument. Formats to list the physical and chemical properties of the sediments are in preparation. Other formats concerning the natural resources and engineering properties of the sea bottom are under consideration.

Finally, the National Oceanographic Data Center does not wish to duplicate the mission of any other agency. Nor do we want to see expensive investigations repeated because the data were unavailable.

U.S. ARMY COASTAL ENGRG. RES. CENTER, CE, WASH. D.C.

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RESEARCH. 37 pp. January 1966

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2. Sedimentation
3. Geomorphology
4. Geology - Structural

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